

Examples of Managed Flow Regimes – Possible Models for the Delta?

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Key Flow Papers

- **Poff, N.L., J.D. Allan, M.B. Bain, J.R. Karr, K.L. Prestegard, B.D. Richter, R.E. Sparks, and J.C. Stromberg. 1997. The natural flow regime. BioScience 47:769-784. (Magnitude, frequency, duration, timing, and rate of change of flows)**
- **Bunn, S.E, and A.H. Arthington. 2002. Basic principles and ecological consequences of altered flow regimes for aquatic biodiversity. Environmental Management 30:492-507. (Four guiding principles on influence of flow regimes)**
- **Petts, G.E. 2009. Instream flow science for sustainable river management. Journal of the American Water Resources Association (JAWRA) 45:1071-1086. (Critical and international perspective on environmental flows)**

Flow Criteria and Regulated Rivers

- **Florida – Southwest Florida Water Management District (SWFWMD)**
- **New Mexico – Middle Rio Grande**
- **Texas Gulf Coast Estuaries**
- **Murray-Darling Basin in Australia**
- **South African Constitutional Mandate**

Setting Flow Criteria for Estuaries and Rivers in the Southwest Florida Water Management District

“The minimum flow for a given watercourse shall be the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area.” Section 373.042 Florida Statutes

Environmental flow is the term for the amount of water needed in a watercourse to maintain healthy, natural, ecosystems. Only a few countries, such as Australia, South Africa, and the United Kingdom have integrated the concept into water management.

Basic Principles and Ecological Consequences of Altered Flow Regimes for Aquatic Biodiversity

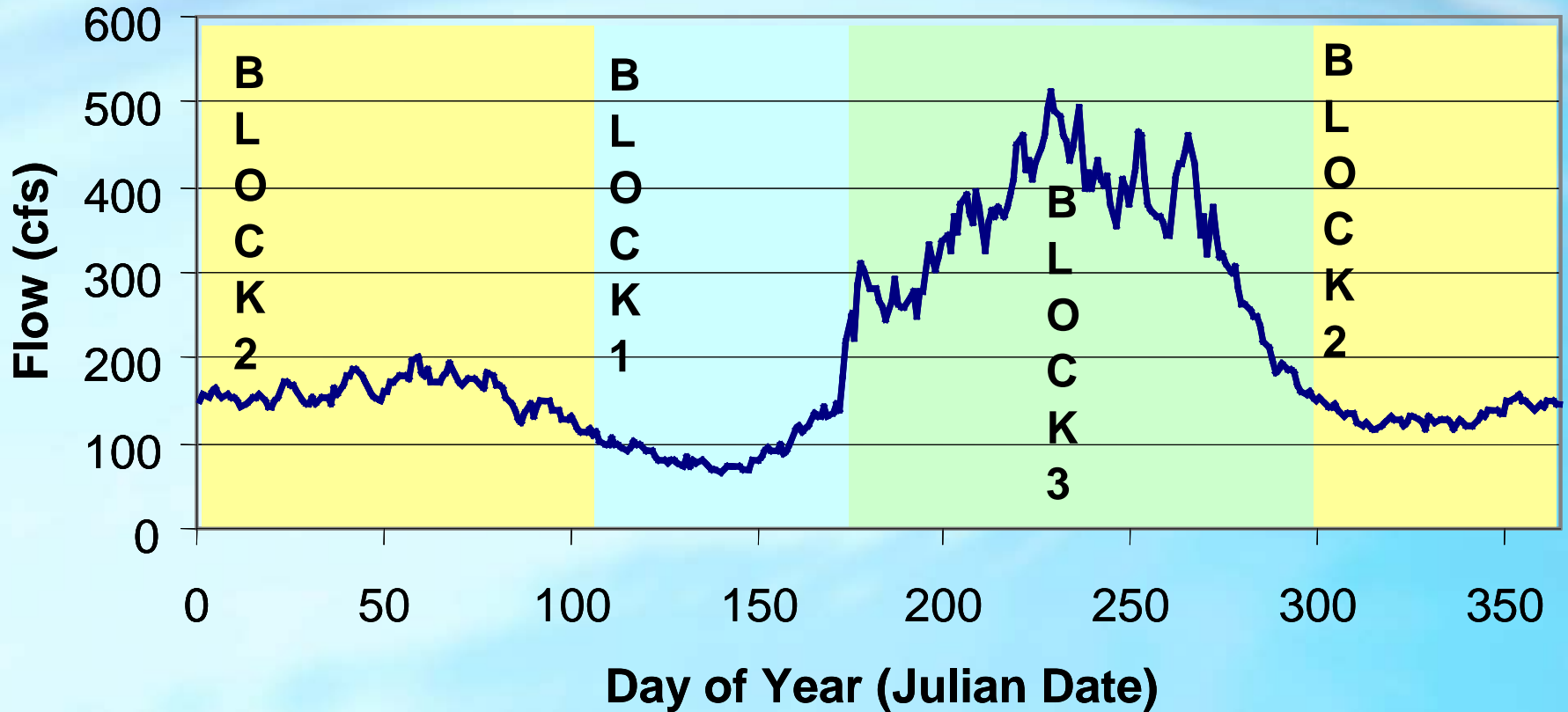
Stuart Bunn and Angela Arthington (2002) Environmental Management
Volume 30 (4): 492-507

- *Principle 1:* Flow is a major determinant of physical habitat, which in turn is a major determinant of biotic composition.
- *Principle 2:* Aquatic species have evolved life history strategies primarily in direct response to the natural flow regime.
- *Principle 3:* Maintenance of natural patterns of longitudinal and lateral connectivity is essential to the viability of populations of many riverine species.
- *Principle 4:* The invasion and success of exotic and introduced species in rivers is facilitated by the alteration of flow regimes.

Approaches and Methods Used for Setting Minimum Flows and Levels (MFLs = Flow Criteria) in Florida

- ***Flow Regime – Building Block Approach***
- ***Multiple MFLs - address seasonality***
- ***Percent of Flow Reduction Technique***
- ***Physical Habitat Simulation (PHABSIM)***
- ***Significant Harm - 15% reduction in available habitat***
- ***River-floodplain-groundwater connection assessed***

Building Block Approach



Habitat Suitability Curves

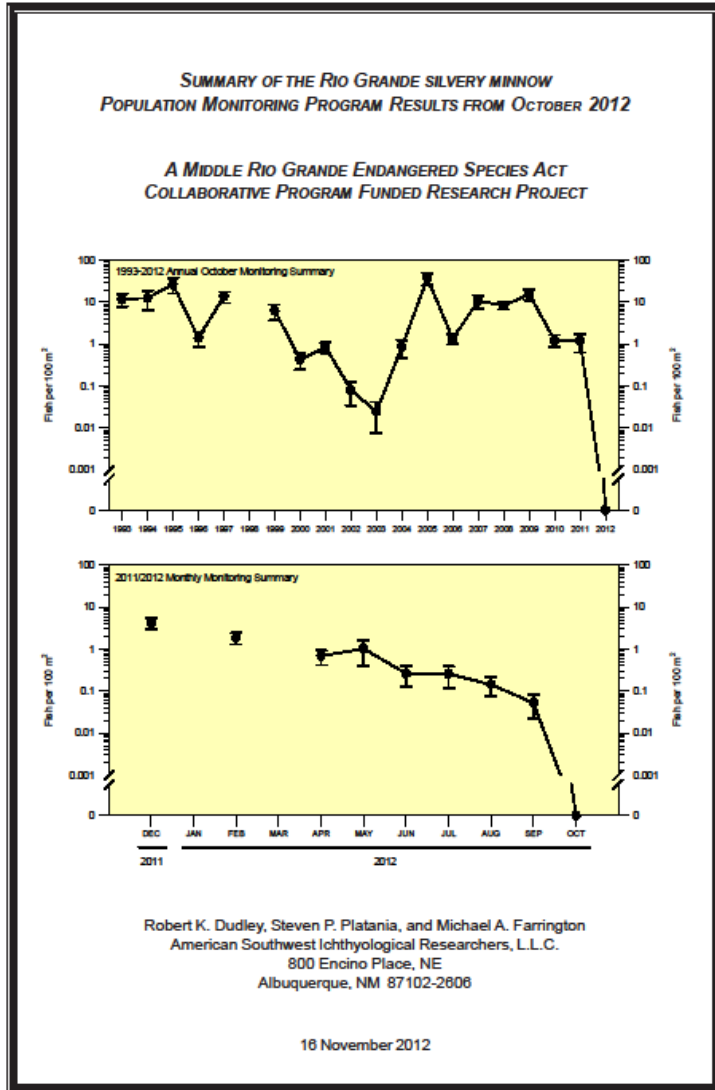
- **Key Non-native Fish Species**
- **Key Native Fish Species**
- **Key Aquatic Macroinvertebrates**
- **Dominant Riparian Plants**
- **Riparian Dependent Bird Species**

Middle Rio Grande, New Mexico



Spring Pulse and Drought

- Rio Grande silvery minnow – broadcast spawner cued by spring snowmelt pulse
- Rio Grande silvery minnow populations at record lows (October 2012)
- Driest 24 month period in recorded history (2011-2012)
- No water for spring pulses in 2011 and 2012
- Highly degraded water quality after largest forest fire in state history (Las Conchas fire summer 2011)



Setting Estuarine Flow Criteria in Texas (River Flow Criteria Already Adopted)

▪ “basin and bay expert science team shall develop environmental flow analyses and a recommended environmental flow regime for the river and bay system ... through a collaborative process designed to achieve consensus”

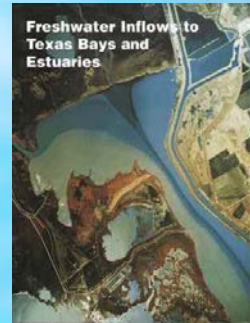
▪ “must consider all reasonably available science, without regard to the need for the water for other uses, and ... the recommendations must be based solely on the best science available”

▪ Texas Water Code §11.02362 (m)
Senate Bill 3 - 2007



Setting Estuarine Flow Criteria in Texas (continued)

- **Statewide Environmental Flows Science Advisory Committee**
- **Bay/Basin Expert Science Teams**
- **Address Seasonal and Yearly Fluctuations**
- **Support a “Sound Ecological Environment”**
- **Maintain Productivity, Extent, and Persistence of
Key Habitats in the Seven Major Estuaries**
- **Stakeholder Committee and State Agencies**



The Murray-Darling Basin

- Supports 3 million people
- Feeds ~ 20 million people
- 14% of Australia
- Australia's 3 longest rivers
- Includes 23 catchments
- 40% of Australia's farmers
- Exports ~ \$ 7 billion/year
- Important native biodiversity
- 2½ times size of California
- 4 States and 1 Territory
- ~15 years of drought (1994-2009)



Australian National Water Act 2007

- “Establishes an independent Murray-Darling Basin Authority with the functions and powers, including enforcement powers, needed to ensure that Basin water resources are managed in an integrated and sustainable way.”
- Water Act 2007 objectives include ensuring environmental sustainability, maximizing net economic returns, sustainable diversion limit for each of the 23 catchments based on science, and consideration of both surface water and groundwater.



Murray River Red Gum

Murray-Darling Basin Authority

Charge for the New Authority

- **Prepare a draft basin plan by 2009 setting sustainable limits on water that can be taken from surface and groundwater systems across the basin (issued in August 2010 – recommends on average about 2.5 million acre feet of water be returned to the environment from current agricultural usage)**
- **Final basin plan is to be approved and in place by 2011**
- **Developing a water rights information service which facilitates water trading across the Murray–Darling Basin**
- **Measure and monitor water resources throughout the Murray-Darling Basin**
- **Gather information (monitoring) and undertake research**
- **Adaptively manage the basin**
- **Engage the community in the management of the Murray-Darling Basin's resources.**



**Mouth of the Murray River
in October 2004**

Constitution of South Africa



- **27. Health care, food, water and social security**
Everyone has the right to have access to -
 - health care services, including reproductive health care;
 - sufficient food and water; and
 - social security, including, if they are unable to support themselves and their dependants, appropriate social assistance.
- **The state must take reasonable legislative and other measures, within its available resources, to achieve the progressive realisation of each of these rights.**

Eight General Principles

- **A modified flow regime should mimic the natural one, so that the natural timing of different kinds of flows is preserved**
- **A river's natural perenniality on non-perenniality should be retained**
- **Most water should be harvested from a river during wet months; little should be taken during dry months**
- **The seasonal pattern of higher baseflows in wet seasons should be retained**

Eight General Principles (cont.)

- **Floods should be present during the natural wet season**
- **The duration of floods could be shortened, but within limits**
- **It is better to retain certain floods at full magnitude and to eliminate others entirely than to preserve all or most floods at diminished levels**
- **The first flood (or one of the first) of the wet season should be fully retained**